

CLAIM AMENDMENTS

This listing of claims will replace all prior versions, and listings, of claims in the application.

1 1. (Previously Presented) A method of determining a placement of services of a
2 distributed application onto nodes of a distributed resource infrastructure comprising
3 the steps of:

4 establishing a placement indicator for a specific service;
5 forming communication constraints between node pairs which ensure that a
6 sum of transport demands between a particular node pair does not exceed a
7 transport capacity between the particular node pair, each term of the sum
8 comprising a product of a first placement variable, a second placement variable,
9 and the transport demand between the services associated with the first and
10 second placement variables;

11 forming an objective; and
12 employing a local search solution to solve an integer program comprising the
13 placement indicator, the communication constraints, and the objective to
14 determine the placement of the services onto the nodes.

1 2. (Original) The method of claim 1 wherein the placement indicator comprises a
2 pre-defined placement.

1 3. (Original) The method of claim 2 wherein the pre-defined placement comprises
2 placing the specific service onto a specific node.

1 4. (Original) The method of claim 2 wherein the pre-defined placement comprises
2 not placing the specific service onto a specific node.

1 5. (Original) The method of claim 1 wherein the placement indicator comprises a
2 neutral indication of whether the specific service is to be placed onto a specific node.

1 6. (Previously Presented) A method of determining a placement of services of a
2 distributed application onto nodes of a distributed resource infrastructure comprising
3 the steps of:

4 establishing an application model of the services comprising transport
5 demands between the services;

6 establishing an infrastructure model of the nodes comprising transport
7 capacities between the nodes;

8 establishing a placement model comprising placement indicators for the
9 services;

10 forming an integer program that comprises:

11 a set of placement variables for a combination of the services and the
12 nodes, each of the placement variables indicating whether a particular service
13 is located on a particular node;

14 communication constraints between node pairs which ensure that a sum of
15 the transport demands between a particular node pair does not exceed the
16 transport capacity between the particular node pair, each term of the sum
17 comprising a product of a first placement variable, a second placement
18 variable, and the transport demand between the services associated with the
19 first and second placement variables;

20 placement constraints for the services which ensure that the services are
21 placed onto the nodes in accord with the placement indicators; and

22 an objective; and

23 employing a local search solution to solve the integer program which
24 determines the placement of the services onto the nodes.

1 7. (Original) The method of claim 6 wherein a particular placement indicator
2 comprises an indication that a specific service is to be placed onto a specific node.

1 8. (Original) The method of claim 6 wherein a particular placement indicator
2 comprises an indication that a specific service is not to be placed onto a specific node.

1 9. (Original) The method of claim 6 wherein a particular placement indicator
2 comprises a neutral indication of whether a specific service is to be placed onto a
3 specific node.

1 10. (Original) The method of claim 9 wherein a default for the placement indicators
2 comprises the neutral indication.

1 11. (Previously Presented) A method of determining a placement of services of a
2 distributed application onto nodes of a distributed resource infrastructure comprising
3 the steps of:

4 establishing an application model of the services that comprises processing
5 demands for the services, storage demands for the services, and transport
6 demands between the services;

7 establishing an infrastructure model of the nodes that comprises processing
8 capacities for the nodes, storage capacities for the nodes, and transport capacities
9 between the nodes;

10 establishing a placement model comprising placement indicators for the
11 services;

12 forming an integer program that comprises:

13 a set of placement variables for a combination of the services and the
14 nodes, each of the placement variables indicating whether a particular service
15 is located on a particular node;

16 processing constraints which ensure that a sum of the processing demands
17 for each of the nodes does not exceed the processing capacity for the node;

18 storage constraints which ensure that a sum of the storage demands for
19 each of the nodes does not exceed the storage capacity for the node;

20 first placement constraints which ensure that each of the services is placed
21 on one and only one node;

22 second placement constraints which ensure that the services are placed
23 onto the nodes in accord with the placement indicators;

24 communication constraints between node pairs which ensure that a sum of
25 the transport demands between a particular node pair does not exceed the
26 transport capacity between the particular node pair, each term of the sum
27 comprising a product of a first placement variable, a second placement
28 variable, and the transport demand between the services associated with the
29 first and second placement variables; and

30 an objective of minimizing communication traffic between the nodes and
31 balancing processing loads on the nodes; and
32 employing a local search solution to solve the integer program which
33 determines the placement of the services onto the nodes.

1 12. (Previously Presented) A computer readable memory comprising computer code
2 for directing a computer to make a determination of a placement of services of a
3 distributed application onto nodes of a distributed resource infrastructure, the
4 determination of the placement of the services onto the nodes comprising the steps of:

5 establishing a placement indicator for a specific service;

6 forming communication constraints between node pairs which ensure that a
7 sum of transport demands between a particular node pair does not exceed a
8 transport capacity between the particular node pair, each term of the sum
9 comprising a product of a first placement variable, a second placement variable,
10 and the transport demand between the services associated with the first and
11 second placement variables;

12 forming an objective; and

13 employing a local search solution to solve an integer program comprising the
14 placement indicator, the communication constraints, and the objective to
15 determine the placement of the services onto the nodes.

1 13. (Original) The computer readable memory of claim 12 wherein the placement
2 indicator comprises a pre-defined placement.

1 14. (Original) The computer readable memory of claim 13 wherein the pre-defined

2 placement comprises placing the specific service onto a specific node.

1 15. (Original) The computer readable memory of claim 13 wherein the pre-defined
2 placement comprises not placing the specific service onto a specific node.

1 16. (Original) The computer readable memory of claim 12 wherein the placement
2 indicator comprises a neutral indication of whether the specific service is to be placed
3 onto a specific node.

1 17. (Previously Presented) A computer readable memory comprising computer code
2 for directing a computer to make a determination of a placement of services of a
3 distributed application onto nodes of a distributed resource infrastructure, the
4 determination of the placement of the services onto the nodes comprising the steps of:

5 establishing an application model of the services comprising transport
6 demands between the services;

7 establishing an infrastructure model of the nodes comprising transport
8 capacities between the nodes;

9 establishing a placement model comprising placement indicators for the
10 services;

11 forming an integer program that comprises:

12 a set of placement variables for a combination of the services and the
13 nodes, each of the placement variables indicating whether a particular service
14 is located on a particular node;

15 communication constraints between node pairs which ensure that a sum of
16 the transport demands between a particular node pair does not exceed the
17 transport capacity between the particular node pair, each term of the sum
18 comprising a product of a first placement variable, a second placement
19 variable, and the transport demand between the services associated with the
20 first and second placement variables;

21 placement constraints for the services which ensure that the services are
22 placed onto the nodes in accord with the placement indicators; and

1 18. (Original) The computer readable memory of claim 17 wherein a particular
2 placement indicator comprises an indication that a specific service is to be placed
3 onto a specific node.

1 19. (Original) The computer readable memory of claim 17 wherein a particular
2 placement indicator comprises an indication that a specific service is not to be placed
3 onto a specific node.

1 20. (Original) The computer readable memory of claim 17 wherein a particular
2 placement indicator comprises a neutral indication of whether a specific service is to
3 be placed onto a specific node.

1 21. (Original) The computer readable memory of claim 20 wherein a default for the
2 placement indicators comprises the neutral indication.

1 22. (Original) The computer readable memory of claim 20 wherein a matrix is
2 specified which expresses constraints or preferences for identifying a placement of
3 services onto nodes.

1 23. (Previously Presented) A computer readable memory comprising computer code
2 for directing a computer to make a determination of a placement of services of a
3 distributed application onto nodes of a distributed resource infrastructure, the
4 determination of the placement of the services onto the nodes comprising the steps of:
5 establishing an application model of the services that comprises processing
6 demands for the services, storage demands for the services, and transport
7 demands between the services;
8 establishing an infrastructure model of the nodes that comprises processing

9 capacities for the nodes, storage capacities for the nodes, and transport capacities
10 between the nodes;

11 establishing a placement model comprising placement indicators for the
12 services;

13 forming an integer program that comprises:

14 a set of placement variables for a combination of the services and the
15 nodes, each of the placement variables indicating whether a particular service
16 is located on a particular node;

17 processing constraints which ensure that a sum of the processing demands
18 for each of the nodes does not exceed the processing capacity for the node;

19 storage constraints which ensure that a sum of the storage demands for
20 each of the nodes does not exceed the storage capacity for the node;

21 first placement constraints which ensure that each of the services is placed
22 on one and only one node;

23 second placement constraints which ensure that the services are placed
24 onto the nodes in accord with the placement indicators;

25 communication constraints between node pairs which ensure that a sum of
26 the transport demands between a particular node pair does not exceed the
27 transport capacity between the particular node pair, each term of the sum
28 comprising a product of a first placement variable, a second placement
29 variable, and the transport demand between the services associated with the
30 first and second placement variables; and

31 an objective of minimizing communication traffic between the nodes and
32 balancing processing loads on the nodes; and

33 employing a local search solution to solve the integer program which
34 determines the placement of the services onto the nodes.